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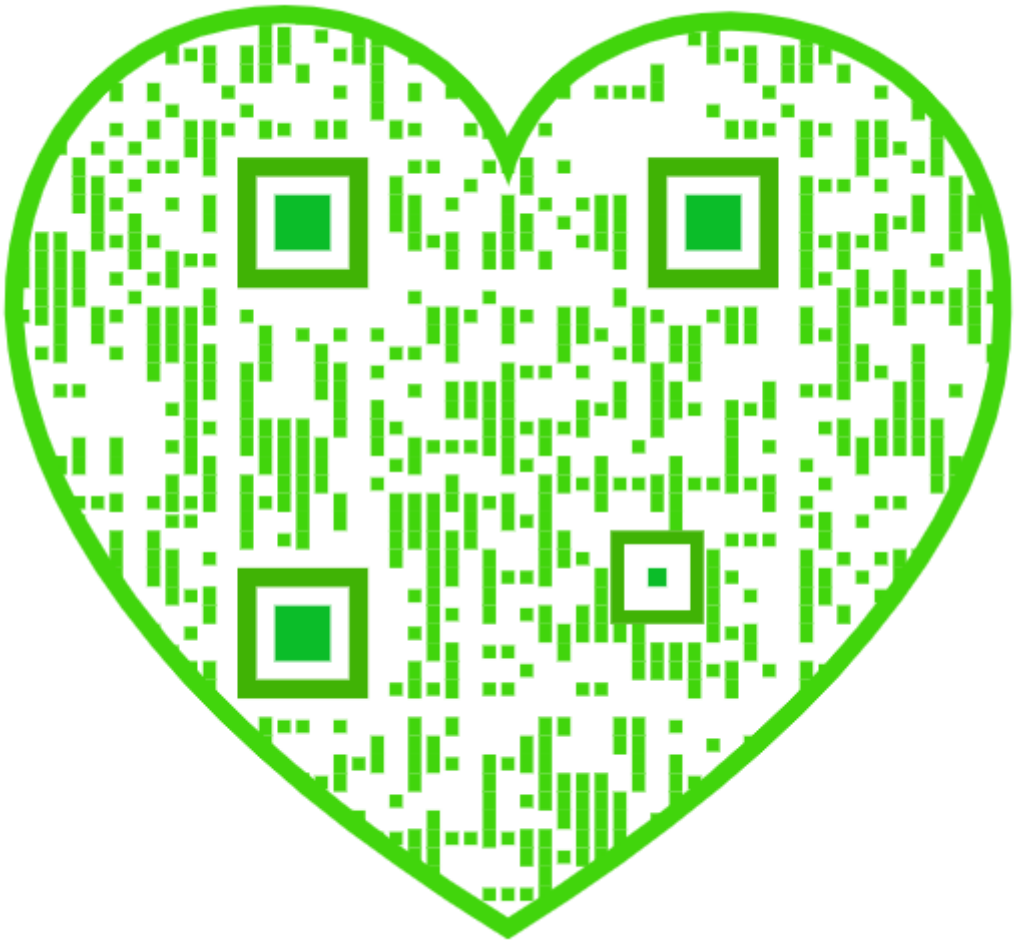
THE SILKWORM

Its History & Product

WINSTED SILK CO
CHICAGO, ILL.
Manufacturers of
Potter's Pure Dye Spool Silk

Price 25 Cents



THE SILKWORM

Its History and Product

Published by

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CHICAGO, ILL.

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THE DISCOVERY OF THE SILKWORM

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JUN 12 1915

THE SILKWORM

THE origin of the silk industry, like many other things in history, is shrouded in the mystery of many legends.

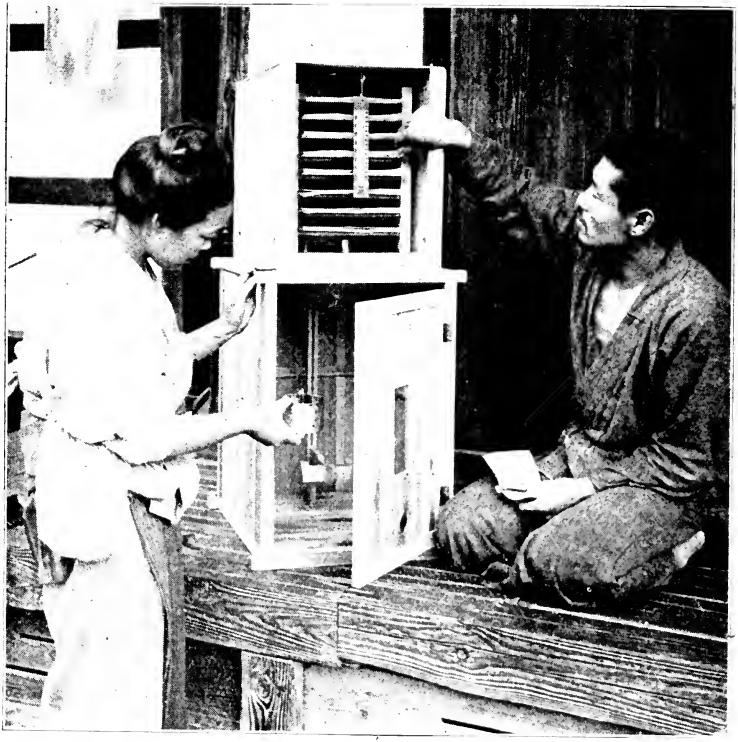
The most authentic and generally believed version, however, is the one that ascribes its beginning to the child-wife of the Chinese Emperor Hoang-ti, who reigned more than a thousand years before Christ.

One day in the early Spring, this little girl, while walking in her garden, noticed some caterpillars feeding upon the leaves of a mulberry tree. They interested her, and so day by day she would go out to watch them.

One day she noticed that they had stopped feeding. They seemed restless, moving their heads from side to side, while from their mouths a semi-liquid, sticky substance was issuing. As they moved their heads, this substance lengthened out and hardened, taking on the appearance of a thin, soft, fairy-like thread. Si-ling-chi, for that, according to the story, is said to have been the name of the little girl, watched the caterpillars industriously winding the slender, silken threads about themselves.

When she again went into the garden her pets had disappeared. In their places were many small, white, fluffy balls half concealed here and there under the mulberry leaves.

She secured one of these little hiding places to see where the caterpillars had gone. Several of the fine threads floated about, and pulling on one of these, Si-ling-chi was astonished



Incubator for Hatching Silkworm Eggs

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to find that though so light it would float in the air, it was sufficiently tough to permit quite a length of it to be unwound before breaking.

She was anxious to unwind all the threads, but the gummy substance with which they were covered held them firmly together. In her search for a way to safely unwind the thread she hit upon a method that is in use to this very day. Si-ling-chi soaked the ball in warm water until the gummy substance was softened. Then she began to unwind one of the threads and was surprised and delighted to find that it lengthened out into a beautiful, lustrous strand several thousand feet long.

This, in brief, is the generally accepted story of the discovery of silk. While it is only a Chinese fable, with no positive assurance of its truth, there is no question but that the silk industry began in China, that birthplace of many wonderful inventions which have since had a marvelous influence upon modern life.

For years the Chinese carefully guarded their secret and made it a source of great wealth. The beautiful silk fabrics woven from the threads spun by the humble caterpillar, or silkworm, as we know it today, gained instant popularity wherever they went.

The manufacture of silk fabrics spread into all parts of Asia, to India, Persia and Arabia, and even into Europe, but the cultivation of the silkworm still remained a secret with the Chinese. Raw silk only was exported to these countries, the exporting of the eggs of the silkworm being punishable by death.

This condition continued until about the middle of the Sixth Century, A. D., when Justinian, the Byzantine Emperor, induced several monks to travel into China and endeavor to secure some of the eggs. They were successful, carrying the silkworm eggs out of China concealed in hollows in their staffs.

Feeding Mulberry Leaves to the Voracious Young Silkworms

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The silkworm thrived under the care of the Greeks, and its culture gradually extended into Syria, Spain and Italy, where it spread to Naples and Northern Italy, and finally into France.

As long ago as 1622 the silk industry was started in America, when James I, of England, sent a quantity of silkworm eggs and mulberry trees to the Virginia planters. This attempt was a failure. With characteristic energy the Americans kept at it, but with indifferent success.

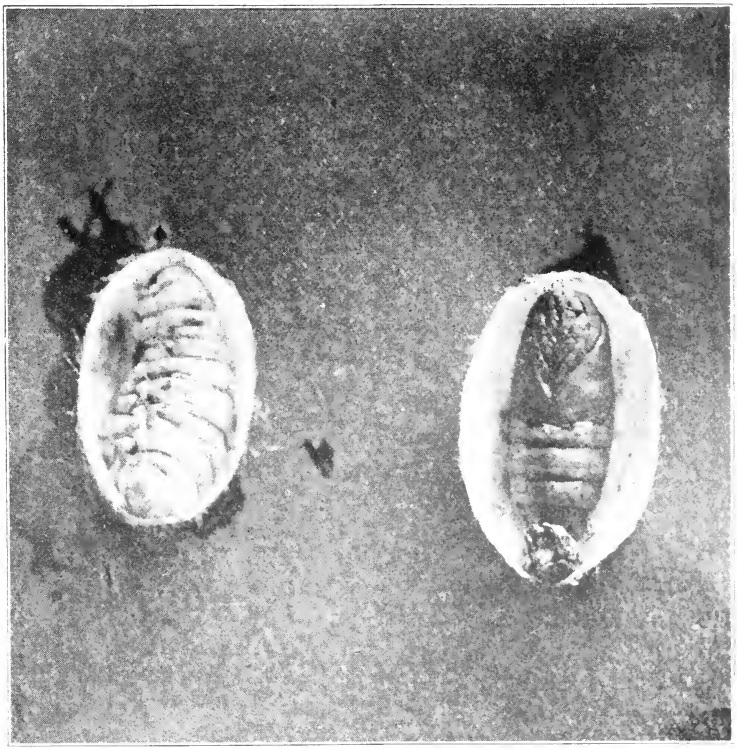
At the present time the cultivation of silkworms is carried on to some extent in California. But no country will ever be able to compete with the far Eastern countries like China, Japan and India, or even France and Italy, because of the labor question. The high rate of wages here is prohibitive to the profitable raising of silkworms. In the Eastern countries, and the old countries of Europe, on the other hand, the people engaged in the silk industry are satisfied, and can live fairly well on an income of ten to twelve cents per day.

The finest silk, of course, comes from the cultivated silkworm, which, through centuries of care, has been developed to a high degree. Wild silk, however, still forms an important part of the raw silk of commerce. The eggs are laid principally by the Tussah Moth, and the natives of China, Manchuria, Siam, India and other Eastern countries make a business of searching for the cocoons.

There are other species which produce silk cocoons, but these cannot be unwound. They are used to make what is called spun silk, a process which we will speak of later on.

The life of the silkworm forms one of the most marvelous cycles of life found in nature. It really exists in four states—the egg, the larva, the chrysalis and the adult, or moth. This entire cycle of life is not much more than two months.

The eggs—or "seed," as the breeders call them—are deposited by a moth known under the scientific names of



Chrysalis in the Cocoon

On the left the worm is seen just entering its sleep. The view on the right shows the chrysalis nearly ready to emerge as a moth. Note the wings folded under the breast

Sericaria mori and *Bombyx mori.* The latter, because the moth that lays silkworm eggs is of the genus of Bombycid moth.

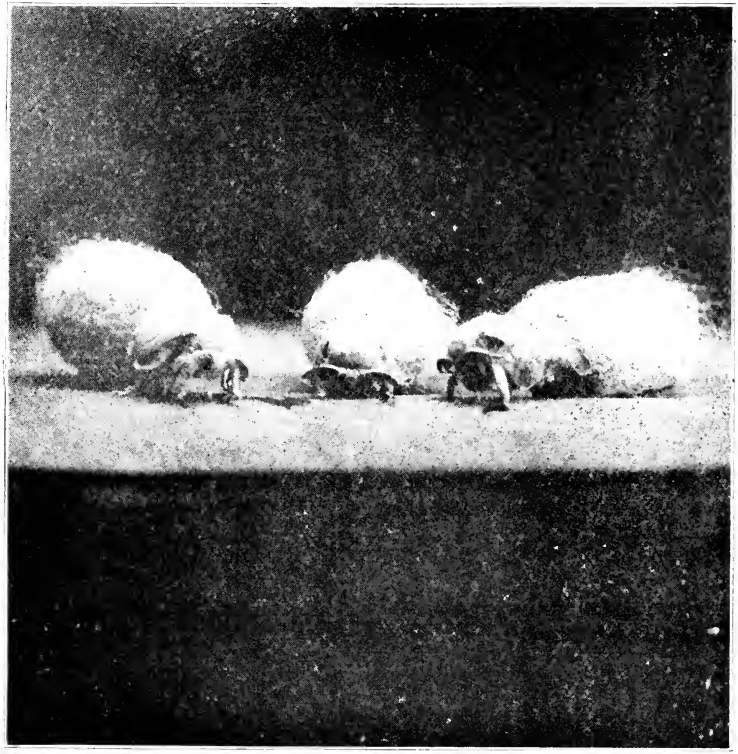
The name Sericaria was derived from the ancient land of Seres, or Sera, said to have been located somewhere in what is now Northern China, and the place where silk was first produced. This has also led to the term Sericulture being applied to the breeding of silkworms.

In the wild state the eggs are deposited on the leaves of the mulberry tree during the summer, but where the worms are cultivated, the moths deposit the eggs on thin sheets of muslin, or paper. The moth does not deposit her eggs in a heap, but spreads them out side by side. It is not known positively why this is done, but probably because if placed one upon the other the little worms would have difficulty in escaping. It is certainly wonderful how instinct guides these little creatures, especially the worm in the spinning of its cocoon.

About 350 is the usual number of eggs deposited. These eggs, of course, are very minute—hardly as large as the head of a pin—round, but slightly flattened, and dull yellow in color. Later they change to gray, growing lighter as the time for hatching approaches. After the exit of the worm the shell is white.

The eggs are collected and allowed to hatch in the Spring, when the mulberry trees come into leaf. Many breeders have three hatchings. The first, or Spring breeding, just after the mulberry trees begin to bud; the Summer breeding, which comes just after the Spring worms have spun their cocoons, and the Autumn breeding. Artificial hatching is carried out by placing the eggs in incubators or rooms heated to about 80 degrees. It takes from ten days to two weeks for the little worms to appear.

The larva, or worm, when hatched is very tiny—not a quarter of an inch in length. It gnaws a hole in the shell, and



Moths Emerging from the Cocoon

This destroys the cocoon for reeling purposes. It can only be used for manufacturing spun silk

after emerging grows rapidly, maturing in about a month (seldom over forty days). When full grown it measures about 3½ inches in length and ¼ inch in thickness.

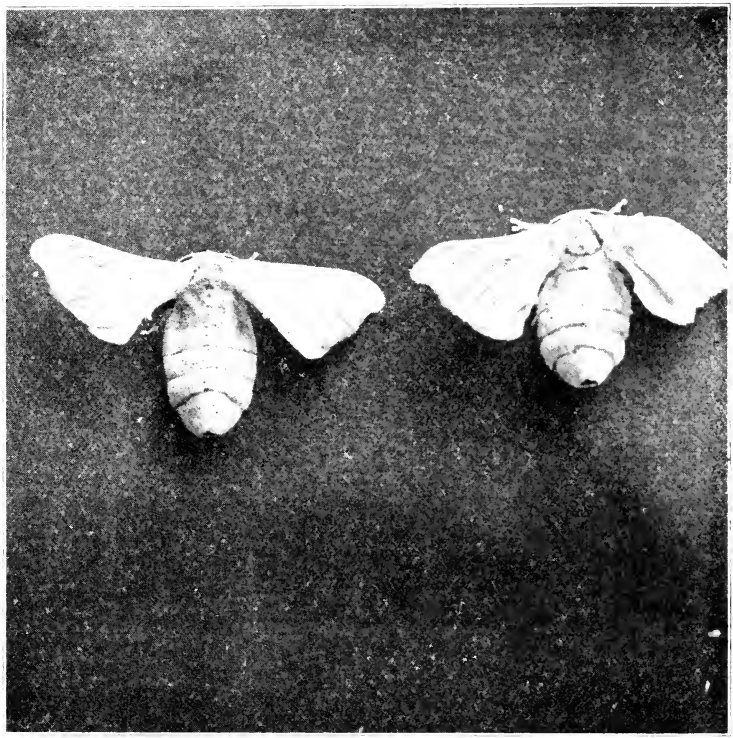
While the silkworm has been called a hairless caterpillar, it really is covered at the beginning of its life with long, stiff hairs. It is black or gray in color, but different shades will come from the same batch of eggs. After the first moult, and as the worm increases in size, the hairs become less noticeable, and the worm gradually gets lighter, becoming in the last stage, a cream-white color. At no time during its life does it become entirely hairless. A microscopic examination will show minute hairs all over its body.

In comparison with the other parts of its body, the silkworm's head is very large. It has a large mouth with powerful jaws for feeding. The body is divided into a dozen segments, the last one having a horn-like projection rising about it. It has six forelegs and ten legs on the hind parts of the body. All the legs are provided with hooks.

The organs with which the silkworm produces its silk consist of two large glands which extend along each side of the body for almost its entire length. These end in two openings in the lower jaw, which are called spinnerets. Each of the two openings have two apertures. The fluid issues from these apertures, and upon being exposed to the air hardens and unites into a single thread from four to seven times finer than a human hair.

From birth the worm is fed upon finely chopped mulberry leaves. The trees must be in a healthy state to secure the best results, and it is said that the leaves from the white mulberry tree are the best for the purpose.

It is a most curious thing to listen to many silkworms eating at the same time. The sound is not unlike that of the soft pattering of a gentle summer rain.



Fully Developed Moths Ready to Lay Their Eggs
The eggs are laid three or four days after emerging from the cocoon and then the moth dies

During its growth the silkworm passes through several moults, or sicknesses, the time between these being commonly called "ages." There are, under normal conditions, four moults, and five ages; the last of the ages is the one just before the worm goes into the cocoon, or chrysalis form.

During the moults the worm ceases to eat, and sheds its skin, which apparently does not grow as fast as the worm. When ready to moult the skin splits in front and the worm wriggles the skin off at the back without moving from the one spot. The time between these moults is about as follows:

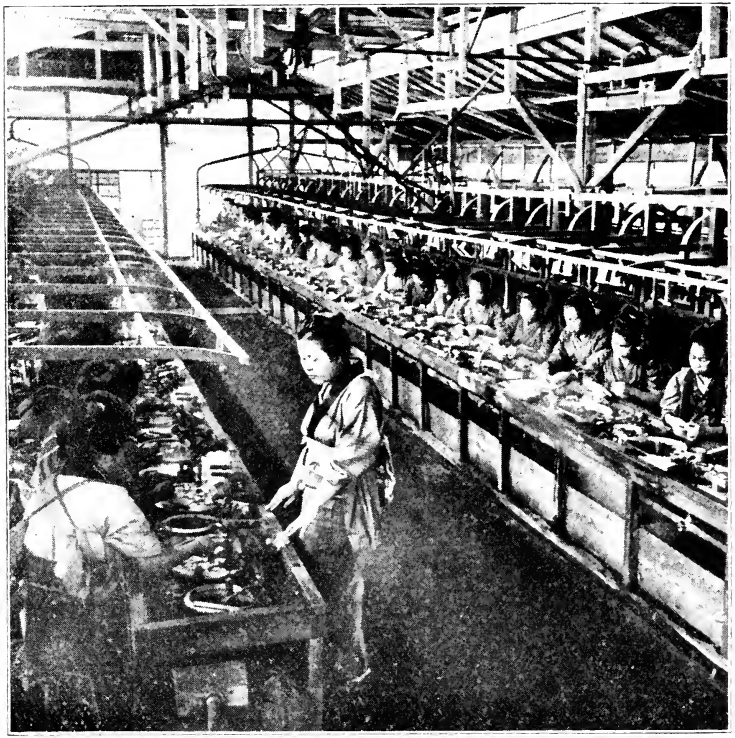
First period, five to six days; second, four to five; third, about five; fourth, five to six; and the fifth, or last, eight to ten. The worm spends about nine days of its month or so of growth in fasting.

At other times, however, the silkworm is a voracious eater. It has been estimated that a worm consumes its own weight of leaves every day that it feeds. During the last few days, just before beginning its work of spinning, it eats more than during its whole previous existence.

When the worm is full grown and ready to spin its cocoon it stops eating and becomes very restless, moving its head about and wandering in search of a suitable place to begin its spinning. The cultivated silkworm at this time generally shows a desire to climb. In the wild state the silkworm usually fastens or sews two mulberry leaves together and spins its cocoon between them.

Breeders of silkworms watch for this stage in its development, and at the proper time arrange some material like branches or straw over and around the worms. The worms climb into this and begin their spinning.

When spinning, the worm attaches itself by means of its five pairs of back legs, leaving the front of the body and head free to move about. It fastens a thread, and then moving its



A Section of the Mammoth Plant of Mitsui Company at Macbashi, Japan
Boiling the Cocoons and Reeling Silk

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head from side to side gradually begins the construction of the cocoon about itself. The threads are wound loosely at first, forming a shell, but as the worm encloses its body by building toward itself they become more regular and closely set. The worm, however, does not spin all the threads round and round its body. Yards and yards of a cocoon can be unreeled without the cocoon turning over.

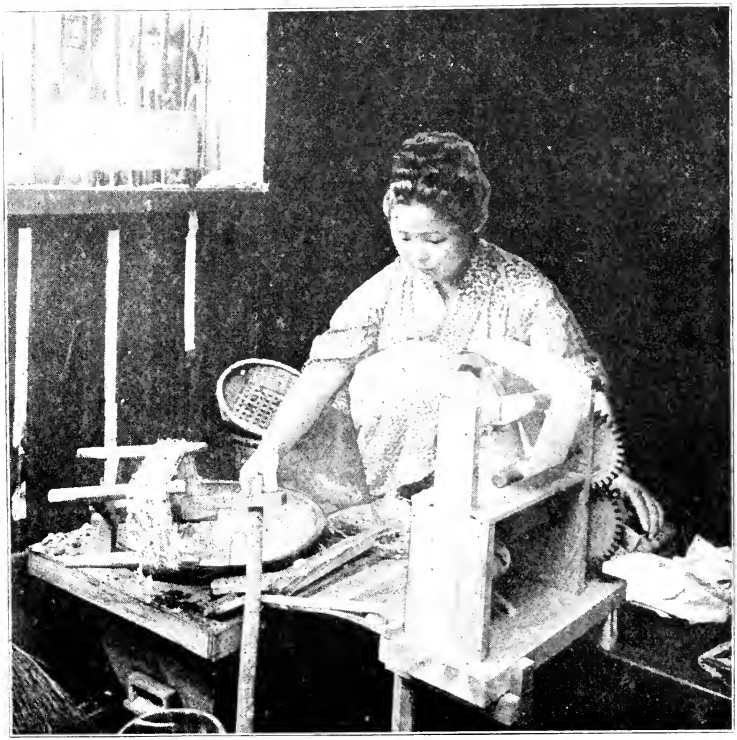
It has been estimated that a silkworm makes about sixty-five motions with its head every minute, and in that time about four to six inches of the filament flow from the spinneret. The gummy substance, which, by the way, forms a large proportion of the thread or filament, causes the filaments to adhere closely and when completed the cocoon forms a solid mass.

The time of spinning a cocoon takes all the way from two to five days, but the latter number is the usual average.

Cocoons are white, yellow and green, but the green do not make as fine a quality of silk, and are harder to bleach. They vary in size and form, but the usual shape is oval, somewhat resembling a peanut. The size averages 1 to 1½ inches in length and from ½ inch to 1 inch in thickness.

About three days after the cocoon is completed the worm passes into the chrysalis form. This is the most phenomenal change known in nature. The worm lies dormant or "sleeping". During this time it again sheds its skin, and in from fifteen to twenty days it awakens a new creature. All the organs of the body, both internal and external, undergo a complete change.

With the shedding of the skin it loses ten of its sixteen legs. The mouth opening disappears, while two large compound eyes, four scaly wings, and two feathery antennae or "feelers" grow. Having no jaws with which to cut its way out, the moth is provided with a liquid secretion, strongly alkaline in its composition. With this it moistens the threads at one end of the cocoon, dissolving the gummy substance, and then forces its way out.



Reeling Silk from Cocoons

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When the grayish-white moth emerges its wings are damp and folded under its breast. They soon dry and expand, and the moth, if a female, is ready to fulfill its mission. It lays its eggs within the next three or four days, and its usefulness being gone, it then dies. During its life the moth never moves more than six inches in any direction from the spot of its birth.

The eggs are collected and stored in a cool place until they are wanted. In Japan the eggs are stored in a natural cold cave called Fuketsu. These are found in nearly all of the silk raising districts, and preserve the eggs indefinitely if necessary.

Of course, when the moth breaks out, the cocoon is spoiled for reeling, and can only be used for making spun silk. For this reason only a few of the moths are allowed to emerge for breeding purposes. The balance of the cocoons are taken as soon as the worm has finished its work and "stoved". That is, the cocoons are placed in ovens to kill the chrysalis, and so preserve the cocoon intact. In some cases the cocoons are placed in boiling water for the same purpose. After the chrysalis is killed the cocoons can be kept for any length of time.

The first step in the manufacture of silk then begins. This is called reeling. The reeling of raw silk is usually conducted as a separate business, and the places where this is done are called "filatures." The cocoons are bought from the breeders, the chrysalis killed, and the cocoons stored until required for reeling. Before reeling, the cocoons are placed in shallow pans of hot water to soften the gum and loosen the ends of the threads, or "floss," which the outside threads of the cocoon are called.

Then a brush, similar to a whisk broom, is stirred in the water and the loose threads attach themselves to it. When the brush is withdrawn from the water it is possible to select the right filament or thread for unwinding or reeling, and this is done

As Precious as Gold. Weighing Skeins of Raw Silk on Delicate Scales in Japan

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direct from the water. The outside threads cannot be used for reeling, but are not wasted, being manufactured into spun silk

Spun silk, which has been referred to several times in this. story, is manufactured in a manner similar to cotton and woolen threads, going through the various process of washing, combing and spinning.

A single cocoon strand which, by the way, runs from 2,000 to 4,000 yards, is too fine for commercial use. Because of this the threads from several cocoons, usually about six or seven, are reeled together. As they are reeled while moist, the natural gum with which they are covered forms them into a single thread. Although the silkworm spins as much as 4,000 yards of thread, there are seldom more than 900 yards available for reeling first quality silk.

After being wound on a reel the silk is then formed into skeins, and becomes the raw silk of commerce. *This is the shape in which it arrives in this country, and is purchased from the silk brokers by the Winsted Silk Company, to be manufactured into the popular sewing silk known as Potter's Silk.*

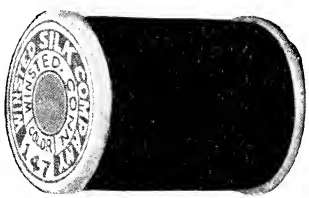
The next step in the manufacture of silk, after it goes into the manufacturers' hands in this country, is "throwing." This is probably derived from an old Anglo-Saxon word, "thrawan," which means to twist, and that is exactly what is done. As the several strands of the raw silk thread are only held together by their natural gum, they would loosen and become entangled in the washing and dyeing processes through which they go.

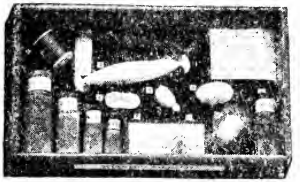
A special machine is used for "throwing." On this the raw silk is unwound from bobbins, twisted, and wound again on reels. *The manufacture of sewing silks like Potter's Pure Dye Spool Silks is simply a continuation of the "throwing."*

After "throwing," the silk thread is sent to the dye house, where it is thoroughly washed by boiling to remove the gummy substance with which it was originally covered, and then dyed in the great variety of shades that permit its being perfectly matched with all colors and shades of fabrics.

A few figures may not be out of place here, and will give some idea of the extreme lightness of silk threads which adds to the difficulty of working it. The original strand as spun by the silkworm is so fine that 22,000 yards of it—*more than five miles*—only weigh *one ounce.* When several threads are wound together to make the usual thread of commerce, it takes over 180 miles of it to weigh *one pound.* It takes in the neighborhood of 3,000 cocoons to make one pound of raw silk. *A spool of Potter's Silk, containing 100 yards of pure silk thread, and retailing for ten cents, requires 150 cocoons.*

WINSTED SILK CO. Chicago, Ill.





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will find it a valuable addition to their courses of study. When purchased by an authorized educational official we will allow a special discount of 50 per cent.

In connection with this story of the silkworm it would be most instructive to have a *real cocoon,* just as spun by the silkworm in some faraway Eastern country. It is an interesting thing, too, to have to show to your friends.

If you will save 5 empty spools that have contained Potter's Sewing Silk, and return them to your dealer, we will send you a real cocoon, imported straight from the breeders. This offer is limited to not over two cocoons to a person. Enclose 2c stamp.

Start right now to save your spools. Get your friends to save them for you. You will be surprised to see how quickly they accumulate. You will be more than delighted when you receive a real cocoon to examine, study and keep.

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